Universiteit Utrecht

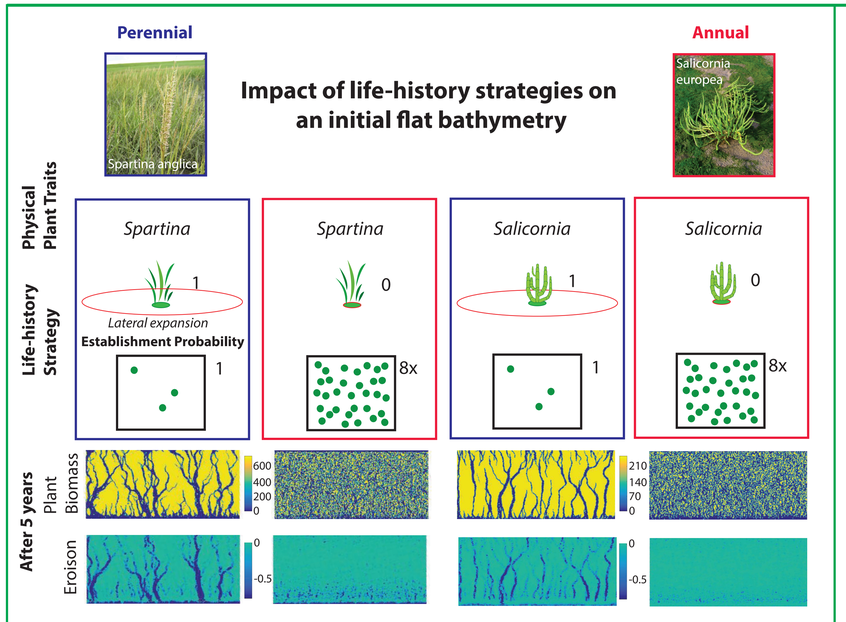
Research Group Ecosystem Management University of Antwerp

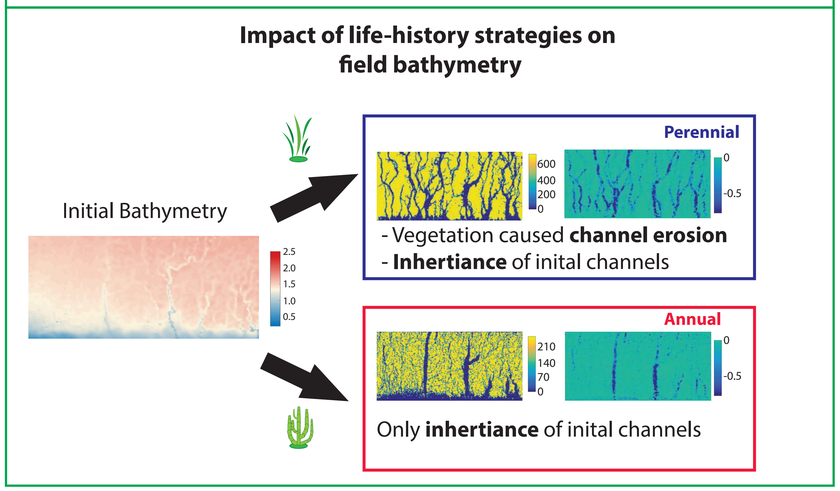
Faculty of Geosciences
Departement of
Physical Geography

How plant life-history traits are steering bio-geomorphologic landscape formation

Christian Schwarz, Jim van Belzen, Zhenchang Zhu, Tjeerd Bouma, Johan van de Koppel, Olivier Gourgue, Nicolas Claude, Stijn Temmerman

Model





Background

Bio-geomorphologic feedbacks in salt marsh ecosystems are based on interactions between above-ground plant-structures and flow, where flow velocities are reduced within and accelerated adjacent to plant patches. These bio-geomorphologic feedbacks were shown to shape geomorphologic landscape features, such as tidal channels. Previously studies focused on the effect of physical plant traits, such as stem density, -rigidity and -height shaping tidal channels, however the effect of plant life-history strategies has been neglected so far.

We investigate the impact of life-history strategies of annual and perennial primary colonizers on landscape development based on field data. Annual plants (represented by *Salicornia eurpoea*) are characterized by high seedling recruitment (establishment probability) without the ability of lateral clonal growth (lateral expansion). Perennial plants (represented by *Spartina anglica*) are characterized by low seedling recruitment and pronounced clonal growth through tillering (fast lateral expansion).

Objective

To test with numerical experiments:

- How different life-history strategies influence the emergence of tidal channels on an initial flat bathymetry
- How different life-history strategies influence the emergence of tidal channels on heterogeneous field bathymetry

Methods

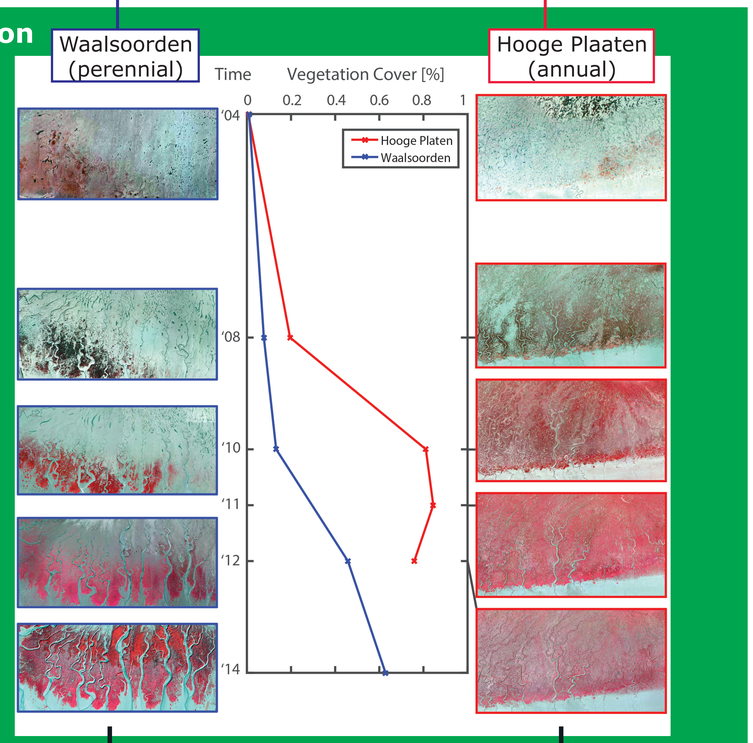
Numerical experiments are conducted, using a hydro-morphodynamic model (TELEMAC2D) based on shoals present in the Western Scheldt estuary coupled with a spatio-temporal plant-growth model.

Results

 # Our model simulations indicate that life-history strategies are major determinants for the shape of emerging tidal channel networks on a flat initial bathymetry

 # Our model simulations indicate that life-history strategies determine whether pre-existing tidal channels get inherited (stabilized) by vegetation or whether stabilization is paired with vegetation caused channel erosion, which is also confirmed through field observations.

Vegetation



Morphology